

Kaloomb and Red Hat

Delivering Tomorrow's Virtual Central Office

Introduction

Next generation telecommunications technologies require modern virtualized environments and, as edge-based services are increasingly deployed, the central office (CO) will experience increasing demand for resources and operational simplicity. Red Hat® virtual central office solution is an edge blueprint built on an open pluggable framework based on Red Hat, Kaloomb™ and other partner technologies, that can be used to deliver mobile, residential and enterprise services. Together with partners, we are building an agile platform that enables innovation and enhances customer experiences.

Kaloomb provides a fully automated virtualized central office networking solution together with Red Hat's network functions virtualization (NFV) infrastructure. The solution leverages a programmable fabric solution to increase the performance and to lower the latency for NFV application servers and storage. It also provides customers with the opportunity to program their infrastructure using the open standards based P4 programming language to add new services quickly. The solution also enhances CPU utilization for virtualized network functions (VNF) and embeds sophisticated service chaining offload functionality to the data plane to accelerate the overall performance and further lower latency.

A reference architecture is shown in figure 1.

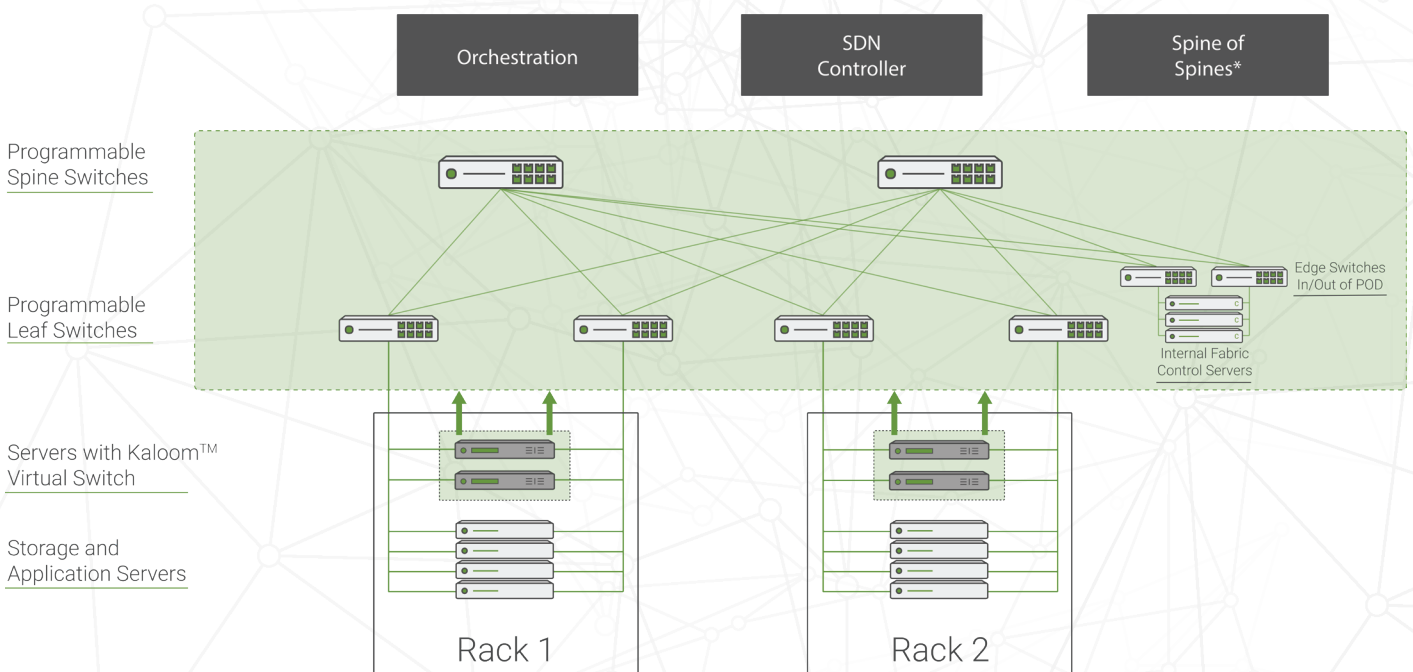


Figure 1: Software Defined Fabric™ Topology.

The following is a list of key attributes regarding the Kaloom reference architecture:

- Enables a multi-vendor Virtual Network Functions (VNF) and Cloud Native Network Functions solution for the Cloud Edge
- An open architecture for 4G and 5G
- Support for software-defined networking (SDN), NFV and cloud technologies to build agile infrastructure for the network edge
- Unified VNF and CNF solution
- Provides advanced service chaining capabilities in hardware that significantly increases performance and lowers latency
- In-band network telemetry and analytics support for the VNFs and CNFs
- Enabled with network slicing enabling full isolation on a per customer basis
- Provides increased performance and lower latency for NFV server and storage
- Facilitates zero touch provisioning and CI-CD standardization across storage, networking and compute
- Provides customers the opportunity to program the infrastructure to add new features and services quickly without waiting for new silicon revisions

Background

The Red Hat virtual central office solution brings NFV and SDN technologies to the CO. New use cases such as industrial IoT (IIoT), extended reality (XR) and vehicle-to-everything (V2X) require lower latency and more demanding edge processing capabilities. Kaloom has a Cloud Edge Fabric™ suited for cloud edge deployments and a Software Defined Fabric™ more suited for hyper-scale data centers as shown in figure 2.

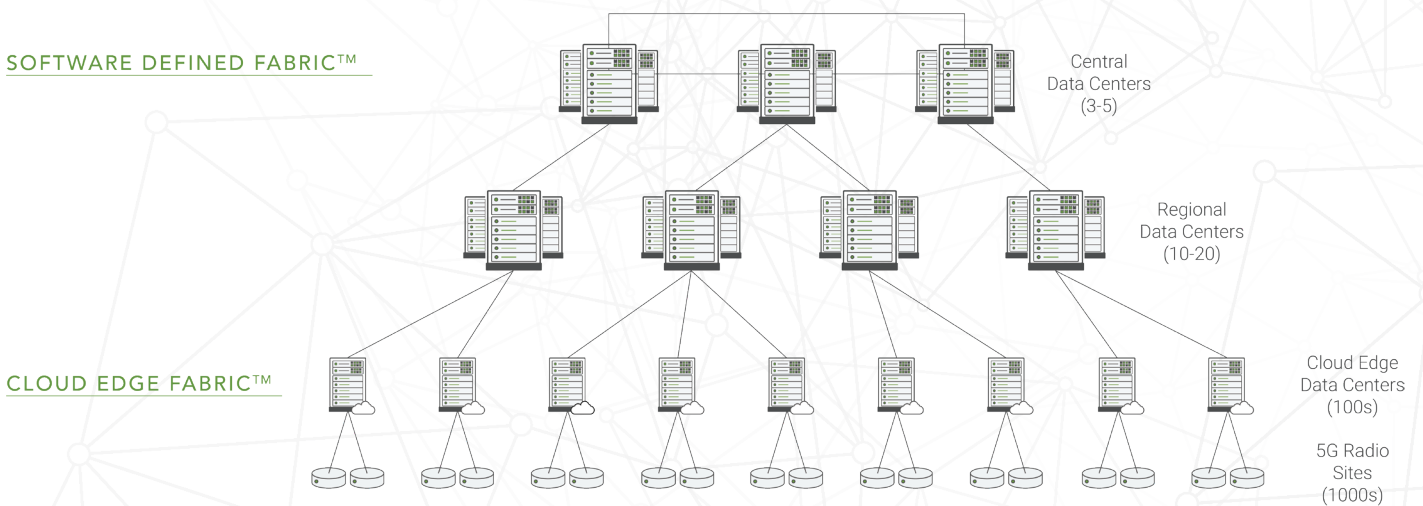


Figure 2: Network Topology for Regional and Cloud Edge Data Centers.

Kaloom's industrialized networking software enables certified solutions for white boxes by using industry commercial off-the-shelf (COTS) hardware. Along with NFV and SDN, communications services providers (CSP) can bring agility, innovation, and improved customer experience to end users while slashing CAPEX and OPEX.

Red Hat and Kaloom jointly strengthened the automation of the NFV infrastructure to disrupt how cloud and data center networks are built, managed and operated for enterprises, cloud providers, gaming companies, data center operators, and communications services providers.

Software Defined Fabric brings true automation to the data center. The platform includes self-discovery and provisioning mechanisms of the nodes into an environment of autonomous networking nodes. Kaloom combines operational simplification and high performance to simplify network management and expand network scale.

Cloud Edge Fabric is designed for high performance, low latency, and automated data center deployments at the edge. The solution offers integrated service chaining offload, in-band telemetry, segments analytics, virtual cloud router, and virtual switch capabilities while allowing customers the opportunity to program new features in-house. It eliminates the need for expensive physical appliances while meeting new emerging requirements by leveraging low-cost networking white boxes to achieve the best cost/performance ratio for deployments at the network edge. The Red Hat virtual central office solution leverages Red Hat Enterprise Linux® CoreOS and Red Hat OpenStack® Platform together with Cloud Edge Fabric, vRouter, vSwitch, vGW for VNF deployments at the network edge. Red Hat OpenStack Platform is used as a common platform, for both NFV Infrastructure and VNF management to ensure an orchestrator agnostic framework. Finally, the consolidation of control plane functions into the virtualized infrastructure and the distribution of the data plane into the programmable network fabric makes this solution capable of delivering residential, mobile and business services as listed below:

Residential VCO Services – For residential users, a VCO can offer virtualized services such as Broadband Network Gateway (vBNG), router, firewall, MEC services (see figure 2), video optimization, VoIP, VPN and additional services, such as email/web hosting, parental controls, cloud storage, security, virus scanning, and cloud backup.

Enterprise VCO Services – For enterprise users, a VCO can offer services such as virtual router, virtual firewall, WAN acceleration, software-defined WAN (SD-WAN), VPN, DNS, PBX, intrusion detection/prevention system (IDS/IPS), CDN, IPSEC, AD/LDAP, content filtering, WLAN and more.

Mobile VCO Services – For mobile users, a VCO can offer services ranging from cloud radio area network (C-RAN), MEC (see above), voice over LTE (VoLTE), IoT, components of vIMS/vEPC to network slicing. Red Hat virtual central office solution is designed to handle those services.

Kaloom and Red Hat Virtual Central Office Solution

The Red Hat virtual central office solution is an open pluggable framework for edge deployments based on Red Hat technologies. These co-engineered, tested, and hardened open source technologies serve as a stable, interoperable base for certified third-party applications and services from Red Hat's comprehensive partner ecosystem. As a key technology partner, Kaloom's products (i.e., Software Defined Fabric™, Cloud Edge Fabric™, Kaloom vSwitch, vRouter, vGW) and technologies are validated to work reliably with Red Hat products, providing more choice when deploying services. Figure 3 provides a high-level graphical overview regarding the Kaloom and Red Hat integration.

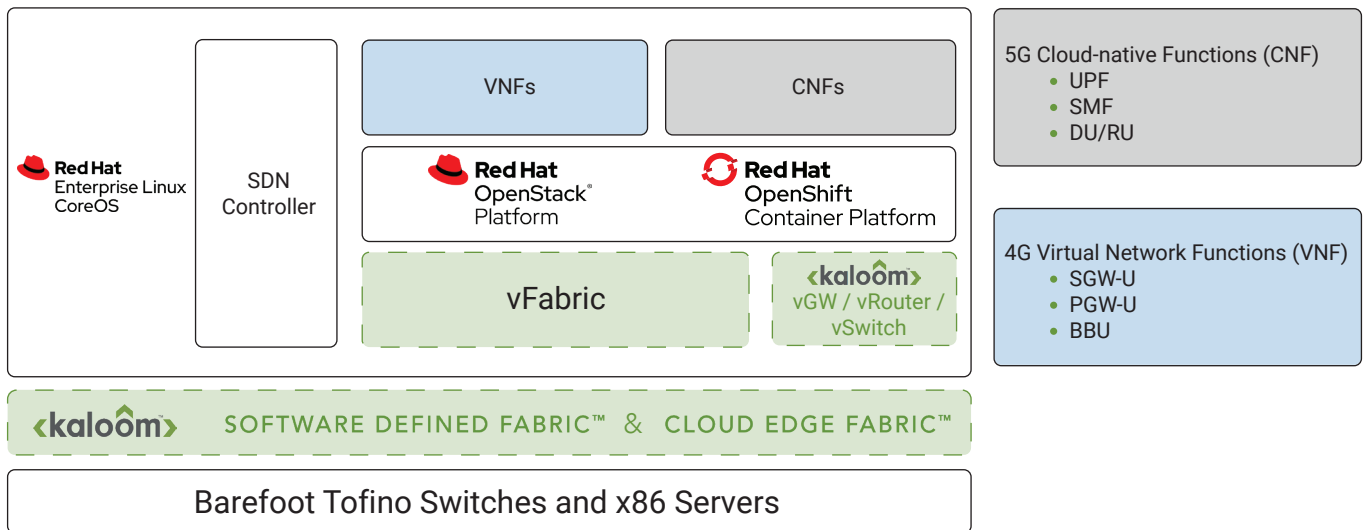
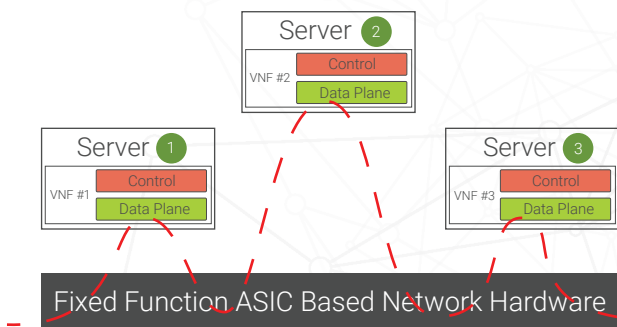


Figure 3: Virtual Central Office Overview

Services Chaining

By leveraging the built-in support of the Cloud Edge Fabric's capability to offload network function processing into the data plane, and to support advanced VNF and CNF services chaining, NFV performance can be greatly improved and latency significantly lowered. The end-to-end latency from initial service point through a services chain to the service destination end point will also be lowered (see figures 4 and 5) whereby the overall network efficiency can be improved by as much as 5-10x.

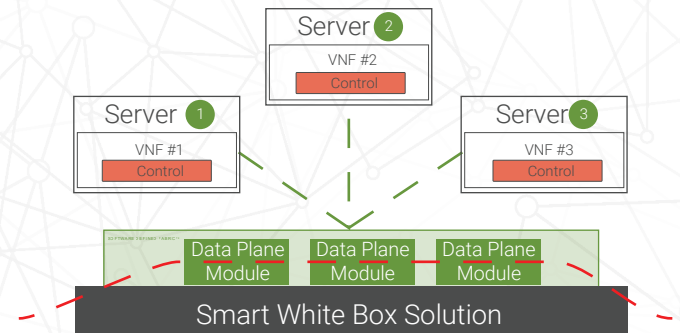
Without Software Defined Fabric



- > High Latency
- > Low Forwarding Performance
- > Independant VNFs

This problem will always exist regardless of the performance improvements of the individual servers

With Software Defined Fabric



- > Ultra Low Latency
- > High Performance, Line Rate Data Path
- > Complex Service Function Chaining
- > Optimized Data Path

Figure 4: VNF infrastructure without data plane offload

Figure 5: VNF Infrastructure with data plane offload and Service Chaining

Kaloom's Virtual Switching (KVS) solution improves the DPDK processing on the server and storage side. It improves how you move a packet from the network into the server and increases the scalability. KVS offloads and improves NIC functionality into the fabric.

VNF Performance Improvements using KVS

Kaloom's KVS offers an innovative virtual switch solution for data center infrastructure providers (DCIPs) and virtual data center operators (vDCOs) such as telecom and cloud service providers, large enterprises, financial institutions, etc. It extends networking functionalities by directly communicating with the Kaloom SDF to offload the virtual switching functionality from the application servers and onto the SDF, thereby delivering more efficient execution of traditional and Kaloom SDF advanced network functions. As an optimized virtual switch replacement for OVS-DPDK, KVS provides a competitive advantage and key benefits in networks where it is deployed. Its use enables the minimization of compute resources, while reducing by as much as 7x the space to user space latency (see figures 6 a, b, c) and increases data throughput (see figures 7a, b, c) by as much as 2x for larger packet sizes. *

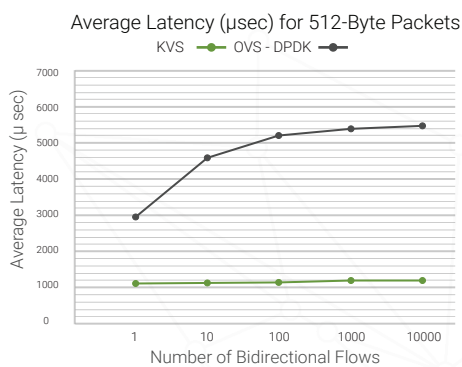


Figure 6a: Average latency performance comparison (KVS vs OVS) for 512-byte packets

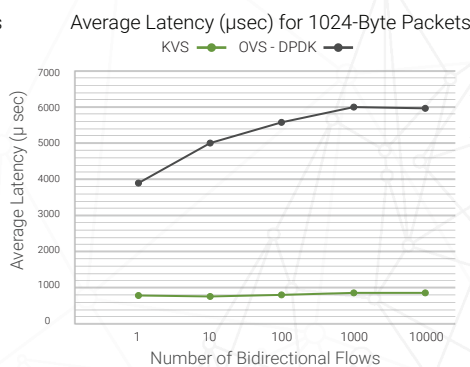


Figure 6b: Average latency performance comparison (KVS vs OVS) for 1024-byte packets

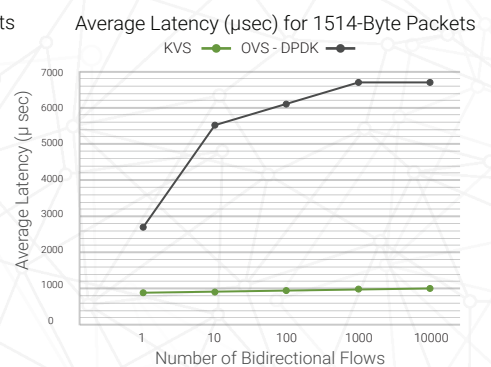


Figure 6c: Average latency performance comparison (KVS vs OVS) for 1514-byte packets

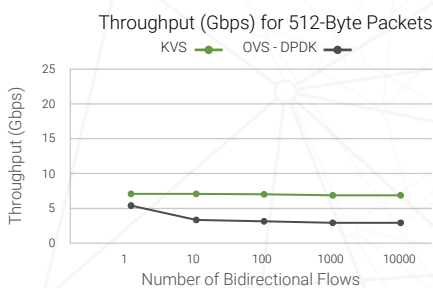


Figure 7a: Throughput performance comparison (KVS vs OVS) for 512-byte packets

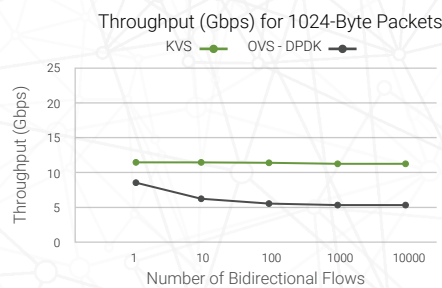


Figure 7b: Throughput performance comparison (KVS vs OVS) for 1024-byte packets

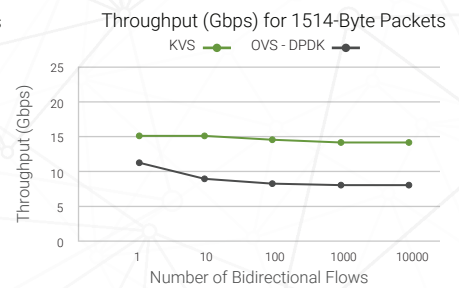


Figure 7c: Throughput performance comparison (KVS vs OVS) for 1514-byte packets

*For additional reference, refer to the Kaloom Virtual Switch Solution Brief document which can be downloaded via: <https://www.kaloom.com/solution-brief-download>

Network Slicing

Cloud Edge Fabric natively supports 5G network slicing whereby an edge data center can be partitioned by a data center infrastructure provider (DCIP) into multiple independent virtual data centers (see figure 8 below), with each virtual data center being provided its own virtual fabric called a “vfabric”. Each virtual datacenter with an associated vfabric can be assigned to a different virtual Data Center Operator (vDCO) or Cloud Service Provider (CSP) that can offer differing SLAs per cloud service user. In this regard, slicing permits multiple operators and large enterprises to share, as Cloud Service Users (CSUs), a common distributed cloud infrastructure, with each CSU enjoying full isolation down to the hardware level for better security and a better quality of experience provided to the individual Cloud Service Consumer (CSC) consuming the services/applications offered by the CSU.

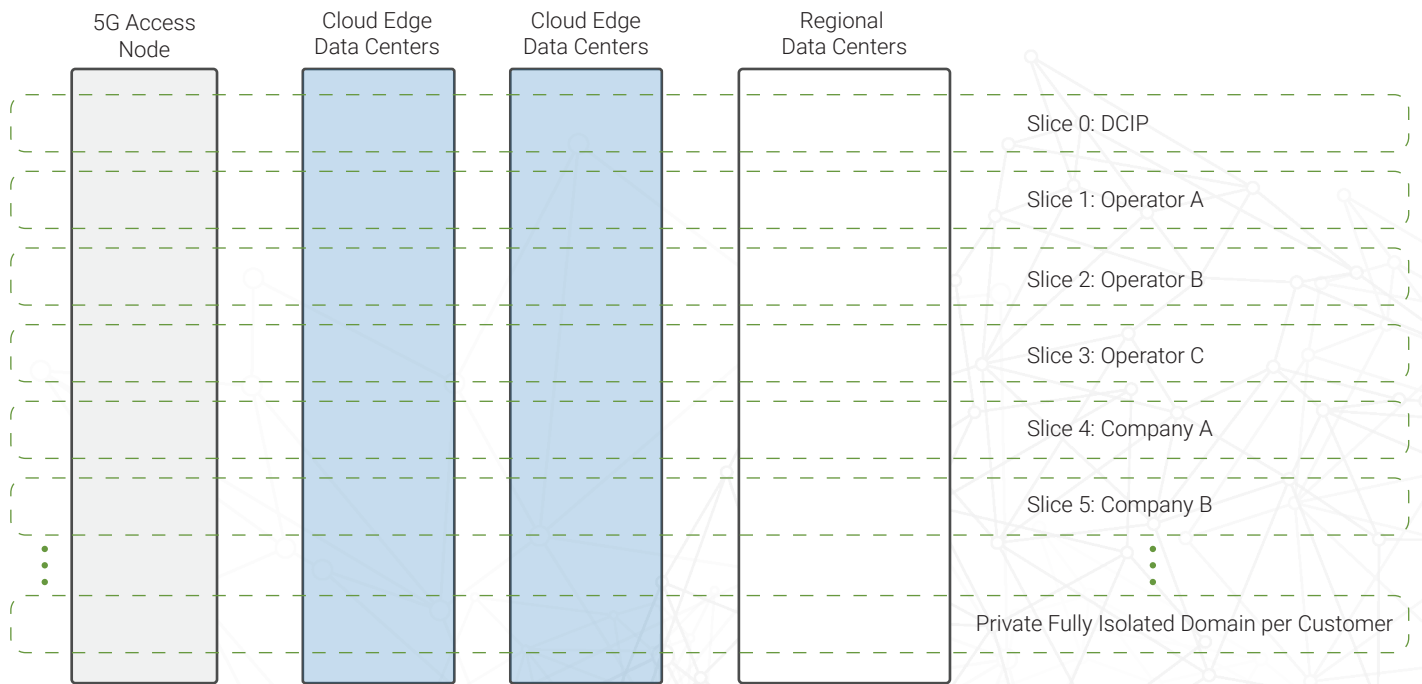


Figure 8: 5G Network Slicing

Conclusion

Kaloom is a key component of the Red Hat virtual central office solution as it provides the fully automated virtualized central office networking solution complementing Red Hat's network functions virtualization infrastructure. As an integral part of the overall multivendor NFV infrastructure solution, Kaloom provides key technology capabilities that enhance VNF/CNF functionality, enabling unparalleled simplicity in deployment and exceptional operational performance.

For more information on Red Hat virtual central office solution, please visit: redhat.com/vco and redhat.com/telco

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